Michael Scheuerer

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Research Interests

Probabilistic weather forecasting, forecast verification, machine learning

Education

Ph.D. Mathematics, University of Göttingen, Germany, 10/2009.

Dissertation: Models and methods for spatial interpolation in statistics and numerical analysis.

Supervisor: Martin Schlather

Diplom Mathematics, University of Bayreuth, Germany, 9/2006.

Employment

Research Associate, Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO, United States, 10/2014 - 12/2020.

Research Associate, NOAA Earth System Research Laboratory, Boulder, CO, United States, 11/2013 - 10/2014.

Research Associate, Institute of Applied Mathematics, Heidelberg University, Germany, 8/2010 - 10/2013.

Research Associate, Institute for Mathematical Stochastics, University of Göttingen, Germany, 10/2009 - 8/2010.

Awards

American Meteorological Society 2021 Editor's award for Monthly Weather Review.

Quarterly Journal Prize Reviewer's Certificate 2019.

Research Associateship award at the National Oceanic and Atmospheric Administration (NOAA) in Boulder, CO, United States, The National Research Council (NRC), 11/2013 - 10/2014.

Professional Service

Associate Editor for *Journal of Hydrometeorology*, 9/2019 - 12/2020.

Associate Editor for *Monthly Weather Review*, 1/2018 - 12/2020.

Associate Editor for *The Annals of Applied Statistics*, 6/2016 - 5/2019.

Reviewer for *Advances in Atmospheric Sciences*, *Advances in Science and Research*, *Advances in Statistical Analysis*, *Advances in Statistical Climatology, Meteorology and Oceanography*, *Advances in Water Resources*, *Atmosphere*, *Atmospheric Research*, *Bayesian Analysis*, *Bernoulli Journal*, *Bulletin of the American Meteorological Society*, *Energies*, *Environmetrics*, *International Journal of Climatology*, *International Journal of Forecasting*, *International Journal of Numerical Modelling*, *Hydrology and Earth System Sciences*, *IEEE Transactions on Neural Networks and Learning Systems*, *IEEE Transactions on Power Systems*, *Journal of Advances in Modeling Earth Systems*, *Journal of Agricultural, Biological, and Environmental Statistics*, *Journal of the Atmospheric Sciences*, *Journal of Climate*, *Journal of*

Geophysical Research, *Journal of Hydrology*, *Journal of Hydrometeorology*, *Journal of the Royal Statistical Society (Series B and C)*, *Meteorologische Zeitschrift*, *Meteorological Applications*, *Meteorology and Atmospheric Physics*, *Mathematical Geosciences*, *Monthly Weather Review*, *Natural Hazards and Earth System Sciences*, *Nonlinear Processes in Geophysics*, *Philosophical Transactions A*, *Quarterly Journal of the Royal Meteorological Society*, *Scandinavian Journal of Statistics*, *SIAM Journal on Imaging Sciences*, *Spatial Statistics*, *Statistics and Computing*, *Statistica Sinica*, *Stochastic Environmental Research and Risk Assessment*, *Technometrics*, *The Annals of Applied Statistics*, *Water*, *Water Resources Research*, *Weather and Forecasting*, *Weather and Climate Extremes*, *WIREs Computational Statistics*, *Wind Energy*.

Member of the local committee of the *International Spring School on Advances and Challenges in Space-Time modelling of Natural Events*, 2010.

Grants and Funding

M. Scheuerer (PI), M. B. Switanek: Develop sub-seasonal regional forecast products for hurricane genesis and frequency. $ 341,010 from NOAA/OAR, 7/2019 - 6/2020.

T. M. Hamill (PI), J. Dias (co-I), L. Bengtsson (co-I), **M. Scheuerer (co-I)** and D. DeWitt (co-I): Improving 1-4 week NOAA forecast guidance of heavy precipitation over California. $ 3,744,719 from NOAA/NWS, 10/2018 - 9/2023.

T. M. Hamill (PI), **M. Scheuerer (co-I)**, D. DeWitt (co-I), and J. Gottschalk (co-I): Development of fire weather related 6-10 and 8-14 day forecast products for NCEP/CPC. $ 600,000 from NOAA/NWS, 7/2018 - 6/2021.

F. Lehner (PI), D. Blatchford (co-I), **M. Scheuerer (co-I)**, H. N.-DeCorse (co-I), A. Wood (co-I), D. Llewellyn (co-I) and T. M. Hamill (co-I): Development of short-range forecasts of weather-driven channel losses and gains to support Reclamation water management. $ 217,000 from Bureau of Reclamation, 10/2018 - 9/2020.

T. M. Hamill (PI) and **M. Scheuerer (co-I)**: Development and transfer of advanced, statistically post-processed probabilistic forecast guidance from ESRL/PSD to NCEP/CPC. $ 60,000 from NOAA/NWS, 4/2017 - 3/2018.

T. M. Hamill (PI) and **M. Scheuerer (co-I)**: Development and transfer of advanced, statistically post-processed probabilistic forecast guidance from ESRL/PSD to NWS/MDL. $125,000 from NOAA/NWS, 4/2017 - 3/2018.

T. M. Hamill (PI) and **M. Scheuerer (co-I)**: Probabilistic Forecasts of Precipitation Type and Snowfall Amounts based on Global Ensemble Forecasts. $171,361 from NOAA/NWS, 5/2015 - 4/2016.

Publications

J. Bellier, **M. Scheuerer** and T. M. Hamill (2020): Precipitation downscaling with Gibbs sampling: An improved method for producing realistic, weather-dependent and anisotropic fields. *Journal of Hydrometeorology*, **21**(11), 2487-2505.

J. Jacobson, **M. Scheuerer**, W. Kleiber and J. Bellier (2020): Beyond univariate calibration: Verifying spatial structure in ensembles of forecast fields. *Nonlinear Processes in Geophysics*, **27**, 411-426.

M. Scheuerer, M. B. Switanek, R. P. Worsnop and T. M. Hamill (2020): Using artificial neural networks for generating probabilistic subseasonal precipitation forecasts over California, *Monthly Weather Review*, **148**(8), 3489-3506.

M. B. Switanek, J. J. Barsugli, **M. Scheuerer** and T. M. Hamill (2020): Present and past sea surface temperatures: A recipe for better seasonal climate forecasts. *Weather and Forecasting*, **35**(4), 1221-1234.

T. M. Hamill and **M. Scheuerer** (2020): Benchmarking the raw model-generated background forecast in rapidly updated surface temperature analyses. Part II: Gridded benchmark. *Monthly Weather Review*, **148**(2), 701-717.

R. P. Worsnop, **M. Scheuerer** and T. M. Hamill (2020): Extended-range probabilistic fire-weather forecasting based on ensemble model output statistics and ensemble copula coupling. *Monthly Weather Review*, **148**(2), 499-521.

M. Scheuerer and T. M. Hamill (2019): Probabilistic forecasting of snowfall amounts using a hybrid between a parametric and an analog approach. *Monthly Weather Review*, **147**(3), 1047-1064.

T. M. Hamill and **M. Scheuerer** (2018): Probabilistic precipitation forecast postprocessing using quantile mapping and rank-weighted best-member dressing. *Monthly Weather Review*, **146**(12), 4079-4098.

M. Scheuerer and T. M. Hamill (2018): Generating calibrated ensembles of physically realistic, high-resolution precipitation forecast fields based on GEFS model output. *Journal of Hydrometeorology*, **19**(10), 1651-1670.

R. P. Worsnop, **M. Scheuerer**, T. M. Hamill and J. K. Lundquist (2018): Generating wind power scenarios for probabilistic ramp event prediction using multivariate statistical post-processing. *Wind Energy Science*, **3**, 371-393.

Y. Zhang, L. Wu, **M. Scheuerer**, J. Schaake, and C. Kongoli (2017): Comparison of probabilistic quantitative precipitation forecasts from two postprocessing mechanisms. *Journal of Hydrometeorology*, **18**(11), 2873-2891.

T. M. Hamill, E. Engle, D. Myrick, M. Peroutka, C. Finan, and **M. Scheuerer** (2017): The US National Blend of Models statistical post-processing of probability of precipitation and deterministic precipitation amount. *Monthly Weather Review*, **145**(9), 3441-3463.

M. Scheuerer, T. M. Hamill, B. Whitin, M. He, and A. Henkel (2017): A method for preferential selection of dates in the Schaake shuffle approach to constructing spatio-temporal forecast fields of temperature and precipitation. *Water Resources Research*, **53**(4), 3029-3046.

M. Scheuerer, S. Gregory, T. M. Hamill, and P. E. Shafer (2017): Probabilistic precipitation type forecasting based on GEFS ensemble forecasts of vertical temperature profiles. *Monthly Weather Review*, **145**(4), 1401-1412.

D. Hodyss, E. Satterfield, J. McClay, T. M. Hamill, and **M. Scheuerer** (2016): Inaccuracies with Multimodel Postprocessing Methods Involving Weighted, Regression-Corrected Forecasts. *Monthly Weather Review*, **144**(4), 1649-1668.

T. L. Thorarinsdottir, **M. Scheuerer**, and C. Heinz (2016): Assessing the calibration of high-dimensional ensemble forecasts using rank histograms. *Journal of Computational and Graphical Statistics*. **25**(1), 105-122.

R. Swinbank, M. Kyouda, P. Buchanan, L. Froude, T. M. Hamill, T. D. Hewson, J. H. Keller, M. Matsueda, J. Methven, F. Pappenberger, **M. Scheuerer**, H. A. Titley, L. Wilson, and M. Yamaguchi (2016): The TIGGE project and its achievements. *Bulletin of the American Meteorological Society*, **97**, 49-67.

M. Scheuerer and D. Möller (2015): Probabilistic wind speed forecasting on a grid based on ensemble model output statistics. *The Annals of Applied Statistics*, **9**(3), 1328-1349.

M. Scheuerer and T. M. Hamill (2015): Statistical post-processing of ensemble precipitation forecasts by fitting censored, shifted Gamma distributions. *Monthly Weather Review*, **143**(11), 4578-4596.

T. M. Hamill, **M. Scheuerer**, and G. T. Bates (2015): Analog probabilistic precipitation forecasts using GEFS Reforecasts and Climatology-Calibrated Precipitation Analyses. *Monthly Weather Review*, **143**(8), 3300-3309.

M. Scheuerer and T. M. Hamill (2015): Variogram-based proper scoring rules for probabilistic forecasts of multivariate quantities. *Monthly Weather Review*, **143**(4), 1321-1334.

K. Feldmann, **M. Scheuerer**, and T. L. Thorarinsdottir (2014): Spatial postprocessing of ensemble forecasts for temperature using nonhomogeneous Gaussian regression. *Monthly Weather Review*, **143**(3), 955-971.

S. Hemri, **M. Scheuerer**, F. Pappenberger, K. Bogner, and T. Haiden (2015): Trends in the predictive performance of raw ensemble weather forecasts. *Geophysical Research Letters*, **41**(24), 9197-9205.

M. Scheuerer and G. König, (2014): Gridded, locally calibrated, probabilistic temperature forecasts based on ensemble model output statistics. *Quarterly Journal of the Royal Meteorological Society*, **140**(685), 2582-2590.

M. Scheuerer and T. Gneiting, (2014): Evaluating predictive performance. *Mathematics of Planet Earth, Lecture Notes in Earth System Sciences*, Springer Berlin Heidelberg, 15-18.

M. Scheuerer, and L. Büermann (2014): Spatially adaptive post-processing of ensemble forecasts for temperature. *Journal of the Royal Statistical Society, Series C*, **63**(3), 405-422.

M. Scheuerer, (2014): Probabilistic quantitative precipitation forecasting using ensemble model output statistics.

Quarterly Journal of the Royal Meteorological Society, **140**(680), 1086-1096.

M. Scheuerer, R. Schaback, and M. Schlather (2013): Interpolation of Spatial Data - A Stochastic or a Deterministic Problem? *European Journal of Applied Mathematics*, **24**, 601-609.

T. L. Thorarinsdottir, **M. Scheuerer**, and K. Feldmann (2012): Statistical post-processing of ensemble forecasts. *Promet* **37**(3/4), 43-52.

M. Scheuerer, and M. Schlather (2012): Covariance models for random vector fields. *Stochastic Models*, **28**(3), 433-451.

M. Scheuerer (2011): An alternative procedure for selecting a good value for the parameter c in RBF-interpolation. *Advances in Computational Mathematics*, **34**(1), 105-126.

M. Scheuerer (2010): Regularity of the sample paths of a general second order random field. *Stochastic Processes and their Applications*, **120**, 1879-1897.

Teaching

Short Courses

Lecture on 'Meteorological and Hydrological Forecast Verification'. CUAHSI Short Course: The Science and Practice of Operational Ensemble Hydrological Prediction, Boulder, CO, United States, 5/2019.

Two lectures on 'Statistical postprocessing". ScienceFore Summer School: The Science of Forecasting, Heidelberg, Germany, 10/2017.

Heidelberg University

Lecturer in Applied Statistical Methods with R, Summer 2010.

University of Göttingen

Teaching assistant in Stochastic Processes, Winter 2007/2008.

Instructor in Practical Course in Statistics, Summer 2007 & Summer 2008.

Advising

Internships

Rochelle Worsnop, *Improving wind ramp predictions through multivariate statistical post-processing of HRRR wind speed forecasts*, NOAA Pathways Program, NOAA/ESRL, 2017. (Joint with Thomas M. Hamill)

Costa Christopoulos, *Evaluation of machine learning techniques for precipitation type forecasting*, Hollings Undergraduate Scholarship, NOAA/ESRL, 2016. (Joint with Thomas M. Hamill)

Marie Boisserie, *Exploration of methods for the post-processing of precipitation forecasts at the sub-seasonal time scale*, Internship program of the École Nationale de la Météorologie (France), NOAA/ESRL, 2016. (Joint with Thomas M. Hamill)

Master's Theses

Joshuah Jacobson, *Beyond Univariate Calibration: Verifying Spatial Structure in Ensembles of Forecast Fields.*, University of Colorado Boulder, 2020. (Joint with William Kleiber)

Diploma Theses

Reza Owji, *Regime-dependent post-processing of ensemble forecasts for precipitation over Germany*, Heidelberg University, 2013. (Joint with Tilmann Gneiting)

Gottlieb König, *The use of covariate information in the post-processing of ensemble forecasts over Germany*, Heidelberg University, 2013. (Joint with Tilmann Gneiting)

Thitiwat Kaew-Amdee, *Doubly robust regression and quantile regression*, Heidelberg University, 2013. (Joint with Tilmann Gneiting)

David Möller, *Spatial aspects with the post-processing of ensemble forecasts for wind speeds over Germany*, Heidelberg University, 2013. (Joint with Tilmann Gneiting)

Luca Büermann, *Spatially adaptive post-processing of ensemble forecasts for temperature over Germany*, Heidelberg University, 2012. (Joint with Tilmann Gneiting)

Kira Feldmann, *Statistical post-processing of ensemble forecasts for temperature: The importance of spatial modeling*, Heidelberg University, 2012. (Joint with Thordis L. Thorarinsdottir)

Jochen Fiedler, *Covariance models based on scale mixtures, multivariate models, and their connections to non-stationary covariance functions*, Heidelberg University, 2011. (Joint with Tilmann Gneiting)

Invited Talks

Using artificial neural networks for generating probabilistic subseasonal precipitation forecasts over California. EUMETNET Workshop on Practical Operational implementation of Statistical Post-Processing for ensemble forecasts, October 2020 (video-conference meeting).

Using artificial neural networks for generating probabilistic subseasonal precipitation forecasts over California. Climate Dynamics webinar series of the Department of Atmospheric, Oceanic, and Earth Sciences, George Mason University, Fairfax, VA, United States, September 2018.

Using artificial neural networks for generating probabilistic subseasonal precipitation forecasts over California. Department of Applied Mathematics, Karlsruhe Institute of Technology, Germany, April 2020 (virtual seminar).

Verification metrics for evaluating the performance of ensemble forecasts of multivariate quantities. VALPRED 2019 Workshop on Assessment of Ensemble Forecasts, Aussois, France, March 2019.

Generating calibrated ensembles of physically realistic, high-resolution precipitation forecast fields based on GEFS model output. Department of Applied Mathematics & Statistics, Colorado School of Mines, Golden, CO, United States, September 2018.

Generating calibrated ensembles of physically realistic, high-resolution precipitation forecast fields based on GEFS model output. Workshop on: Forecasting from Complexity, Minneapolis, MN, United States, April 2018.

Generating spatio-temporal precipitation forecast fields based on the output of the global ensemble forecast system (GEFS) (Core Science Keynote). AMS Annual Meeting, Austin, TX, United States, January 2018.

Generating spatio-temporal precipitation forecast fields based on the output of the global ensemble forecast system (GEFS). CAWCR Annual Workshop 2017, Melbourne, Australia, November 2017.

Generating spatio-temporal precipitation forecast fields based on the output of the global ensemble forecast system (GEFS). 3rd Annual Meeting of the 'Waves to Weather' Collaborative Research Center, Kempten, Germany, November 2017.

Probabilistic precipitation type forecasting based on GEFS ensemble forecasts of vertical temperature profiles. Department of Statistical Science, Baylor University, Waco, TX, United States, February 2016.

Evaluating the performance of probabilistic forecasts of univariate and multivariate quantities. Department of Atmospheric Sciences, University of Utah, UT, United States, June 2016.

Emerging methods for post-processing. Workshop on: The Future of Statistical Post-Processing in NOAA and the Weather Enterprise, College Park, MD, United States, January 2016.

Statistical post-processing of ensemble forecasts: recent developments and current issues. AMS Annual Meeting, New Orleans, LA, United States, January 2016.

Statistical post-processing of GEFS ensemble forecasts for precipitation accumulations. RAL seminar series, NCAR,

Boulder, CO, United States, July 2015.

Evaluating the performance of probabilistic forecasts of univariate and multivariate quantities. Department of Applied Mathematics & Statistics, Colorado School of Mines, Golden, CO, United States, January 2015.

Evaluating the performance of probabilistic forecasts of univariate and multivariate quantities. Department of Applied Mathematics, University of Colorado at Boulder, CO, United States, December 2014.

Variogram-based proper scoring rules for probabilistic forecasts of multivariate quantities. Workshop on High-dimensional, High-frequency, and Spatial Data, Karlsruhe Institute of Technology, Germany, October 2014.

Sample path properties of random fields and random vector fields. University of Bern, Institute of Mathematical Statistics and Actuarial Science, Switzerland, October 2013.

Probabilistic quantitative precipitation forecasting using ensemble model output statistics. Royal Meteorological Institute of Belgium, Bruxelles, Belgium, June 2013.

Statistical models for spatial dependence structures of precipitation fields. German-Polish Joint Conference on Probability Theory and Mathematical Statistics, Torun, Poland, June 2013.

Wetter und Wahrscheinlichkeit – Statistische Modelle in der Wettervorhersage. WiMa-Kongress 2012, University of Ulm, Germany, November 2012.

Modelling the spatial dependence structure of precipitation fields. S^4G: 7th International Conference of Stereology, Spatial Statistics and Stochastic Geometry, Prague, Czech Republic, June 2012 (talk in minisymposium).

Covariance models for spatial or spatio-temporal random vector fields. Workshop on "Spatio-temporal Statistics and Applications to Environment", AgroParisTech, Paris, France, March 2012.

Statistische Modellierung räumlicher Abhängigkeiten in Niederschlagsfeldern. University of Bonn, Meteorological Institute, Germany, July 2011.

Kernel interpolation beyond the native space - a statisticians perspective. Workshop on "Kernel Functions and Meshless Methods" honoring the 65th birthday of Robert Schaback, University of Göttingen, Institute for Numerical and Applied Mathematics, Germany, January 2011.

Other

Language skills: German (native speaker), English (fluent), French (advanced), Spanish (advanced)

Programming skills: Python, R, Fortran

Avid rock climber, mountain biker, backcountry skier and packrafter.

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